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EXAMINER

VINH, LAN

ART UNIT	PAPER NUMBER
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1765

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DATE MAILED: 09/09/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

115 2

# Office Action Summary

Application No.

09/769,812

Applicant(s)

LIN ET AL.

Examiner

Lan Vinh

Art Unit

1765

-- The MAILING DATE of this communication appears on the cover sheet with the corresponding address --

## Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

## Status

- 1) ☒ Responsive to communication(s) filed on 26 January 2001.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

## Disposition of Claims

- 4) ☒ Claim(s) 1-26 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-26 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

## Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on \_\_\_\_\_ is: a) ☐ approved b) ☐ disapproved by the Examiner.  
If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

## Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).  
a) ☐ All b) ☐ Some \* c) ☐ None of:  
1. ☐ Certified copies of the priority documents have been received.  
2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.  
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).  
\* See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).  
a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

## Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 2.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

## **DETAILED ACTION**

### ***Claim Objections***

1. Claims 1, 3, 4, 11, 12, 13, 19, 20, 21 are objected for the following informalities: In line 9 of claim 1, line 8 of claims 11 and 19, there are no linking word between the terms "using an etch process" and "said organic low k dielectric layer". The examiner suggests inserting the word "to etch" between the terms "using an etch process" and "said organic low k dielectric layer" to make the claim language understandable.

In line 2 of claims 3 and 4, lines 2-3 of claims 12, 13, 20, 21, the term "medium plasma power plasma density" appears to be grammatically incorrect. Appropriate correction is required.

### ***Claim Rejections - 35 USC § 102***

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or  
(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

3. Claims 1, 5, 6, 8, 10 are rejected under 35 U.S.C. 102(e) as being anticipated by Ye et al (US 6,080,529 )

Art Unit: 1765

Ye discloses a method for etching patterned layer useful as masking for damascene structure. This method comprises the step of:

forming an organic low k dielectric layer 404 (polyarylene ether ) over a substrate ( col 21, lines 44-45 )

forming a patterned hard mask layer 402 over low k dielectric layer 404, the layer 402 having openings ( col 21, lines 44-45; fig.4A)

etching the low k dielectric layer 404 through the openings on the masking/resist pattern 402 using an etch process, the etch process is conducted by applying bias plasma power to  $\text{NH}_3$  gas in the chamber (col 22, lines 39-42 )

Regarding claims 5-6, 8, Ye discloses that low k dielectric layer 404 made of polyarylene ether ( col 21, lines 48-50 )

Regarding claim 10, Ye discloses substrate 408 is made of aluminum/microelectronics conductor material.

4. Claims 11, 14, 15, 17 are rejected under 35 U.S.C. 102(e) as being anticipated by Ye et al (US 6,080,529 )

Ye discloses a method for etching patterned layer useful as masking for damascene structure. This method comprises the step of:

forming an organic low k dielectric layer 404 (polyarylene ether ) over an insulating layer 406 over a substrate ( col 21, lines 44-47 )

forming a patterned hard mask layer 402 over low k dielectric layer 404, the layer 402 having openings ( col 21, lines 44-45; fig.4A)

Art Unit: 1765

etching the low k dielectric layer 404 through the openings on the masking/resist pattern 402 using an etch process, the etch process is conducted by applying bias plasma power and flowing plasma source gas combination of ammonia/NH<sub>3</sub> gas with hydrogen/H<sub>2</sub> gas ( col 20, lines 65-67 )

Regarding claims 14-15, 17, Ye discloses that low k dielectric layer 404 made of polyarylene ether ( col 21, lines 48-50 )

### ***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

6. Claims 2-4, 12-13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Bhardwaj et al (US 6,051,503).

Ye method has been described above in paragraph 3. Although Ye discloses flowing 70 sccm of NH<sub>3</sub> gas (overlaps the claimed range of 50-300 sccm ) and oxygen gas into the chamber at subatmospheric pressure while applying plasma power(col 12, lines 20-21; col 22, lines 41-42 ), Ye does not disclose the specific values of the plasma density, power and pressure as recited in claims 2-4, 12-13.

However, Bhardwaj, in a method of surface treatment using plasma, teaches that plasma density, plasma power and chamber pressure are parameters that can be varied to change the etch rate (col 2, lines 10-16 )

Art Unit: 1765

Hence, one skilled in the art would have found it obvious to modify Yeng's method by varying the process parameters in view of Bhardwaj's teaching through routine experimentation to obtain particular values in order to achieve desirable etch rate.

7. Claims 7, 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Naik et al (US 6,245,662 )

Ye method has been described above in paragraph 3. Ye differs from the instant claimed inventions as per claims 7, 16 by forming a low k dielectric layer of polyarylene ether instead of carbon doped oxide.

However, Naik, in a method for forming interconnect structure, teaches that polyarylene ether or carbon doped oxide (Black diamond ) can be used as low k dielectric material in an interconnect structure ( col 3, lines 51-60 )

Hence, one skilled in the art would have found it obvious to substitute Yeng polyarylene ether low k dielectric layer with carbon doped oxide in view of Naik's teaching because both materials are known low k dielectric materials, thus the substitution of one for the other would have been anticipated to produce an expected result.

8. Claims 9, 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of McReynolds (US 6,191,043 )

Ye method has been described above in paragraph 3. Unlike the instant claimed inventions as per claims 9, 18, Ye does not specifically disclose forming a first opening

Art Unit: 1765

through the low k dielectric layer, the opening having sidewalls that are substantially vertical at a angle between 87-93 degree to the surface of the substrate although Ye discloses forming contact via/opening 405 through the low k dielectric layer 404.

However, McReynolds discloses a method for etching a silicon layer comprises the step of the using plasma etching to etch an opening having sidewalls at a angle between 87 degree to the surface of the substrate (col 3, lines 20-22 )

Hence, one skilled in the art would have found it obvious to modify Ye method by etching an opening having sidewalls at a angle of 87 degree to the surface of the substrate as taught by McReynolds because McReynolds teaches that opening having straight vertical profile (sidewalls at a angle of 87) has no problematic characteristics such as the bowed features that result from undercutting the hard mask ( col 5, lines 30-33 )

9. Claims 19, 22-24, 25 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ngo et al (US 6,436,808 )

Ye discloses a method for etching patterned layer useful as masking for damascene structure. This method comprises the step of:

forming an organic low k dielectric layer 404 (polyarylene ether ) over an insulating layer 406 over a substrate ( col 21, lines 44-47 )

forming a patterned hard mask layer 402 over low k dielectric layer 404, the layer 402 having openings ( col 21, lines 44-45; fig.4A)

Art Unit: 1765

etching the low k dielectric layer 404 through the openings on the masking/resist pattern 402 using an etch process, the etch process is conducted by applying bias plasma power to  $\text{NH}_3$  gas in the chamber (col 22, lines 39-42 )

Unlike the instant claimed invention as per claim 19, Ye fails to disclose flowing only  $\text{NH}_3$  gas and  $\text{N}_2$  to etch the organic low k dielectric layer.

However, Ngo discloses a method for treating/etching semiconductor structure comprises the step of etching a low k dielectric layer using  $\text{NH}_3$  and  $\text{N}_2$  plasma (col 4, lines 40-42 )

Hence, one skilled in the art would have found it obvious to modify Ye's step of etching the low k dielectric layer by etching a low k dielectric layer using  $\text{NH}_3$  and  $\text{N}_2$  plasma as per Ngo because Ngo states that  $\text{NH}_3/\text{N}_2$  plasma substantially prevents or significantly reduces degradation such that the dielectric constant, shrinkage do not undergo a change in excess of 3% ( col 4, lines 43-47 )

Regarding claims 22-23, 25, Ye discloses that low k dielectric layer 404 made of polyarylene ether ( col 21, lines 48-50 )

The limitation of claim 24 has been discussed above in paragraph 7.

10. Claims 20-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ngo et al (US 6,436,808 ) and further in view of Bhardwag et al (US 6,051,503).

Ye as modified by Ngo has been described above in paragraph 9. Although Ye discloses flowing 70 sccm of  $\text{NH}_3$  gas (overlaps the claimed range of 50-300 sccm ) and



Art Unit: 1765

oxygen gas into the chamber at subatmospheric pressure while applying plasma power(col 12, lines 20-21; col 22, lines 41-42 ), Ye and Ngo do not disclose the specific values of the plasma density, power and pressure as recited in claims 2-4, 12-13.

However, Bhardwaj, in a method of surface treatment using plasma, teaches that plasma density, plasma power and chamber pressure are parameters that can be varied to change the etch rate (col 2, lines 10-16 )

Hence, one skilled in the art would have found it obvious to modify Yeng and Ngo method by varying the process parameters in view of Bhardwaj's teaching through routine experimentation to obtain particular values in order to achieve desirable etch rate.

11. Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ye et al (US 6,080,529 ) in view of Ngo et al (US 6,436,808 ) and further in view of 6,080,529 ) in view of McReynolds (US 6,191,043 )

Ye method as modified by Ngo has been described above in paragraph 9. Unlike the instant claimed inventions as per claim 26, Ye and Ngo not specifically disclose forming a first opening through the low k dielectric layer, the opening having sidewalls that are substantially vertical at a angle between 87-93 degree to the surface of the substrate although Ye discloses forming contact via/opening 405 through the low k dielectric layer 404.

However, McReynolds discloses a method for etching a silicon layer comprises the step of the using plasma etching to etch an opening having sidewalls at a angle between 87 degree to the surface of the substrate (col 3, lines 20-22 )

Hence, one skilled in the art would have found it obvious to modify Ye and Ngo method by etching an opening having sidewalls at a angle of 87 degree to the surface of the substrate as taught by McReynolds because McReynolds teaches that opening having straight vertical profile (sidewalls at a angle of 87) has no problematic characteristics such as the bowed features that result from undercutting the hard mask ( col 5, lines 30-33 )

### ***Conclusion***

12. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lan Vinh whose telephone number is 703 305-6302. The examiner can normally be reached on M-F 8:30-5:30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Benjamin Utech can be reached on 703 308-3836. The fax phone numbers for the organization where this application or proceeding is assigned are 703 872-9310 for regular communications and 703 872-9311 for After Final communications.

LV  
September 4, 2002

  
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